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[54] **CONNECTOR**

5,651,693 7/1997 Fukuda et al. .

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FOREIGN PATENT DOCUMENTS

[73] Assignee: **Sumitomo Wiring Systems, Ltd.,**
Japan

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89 13 061 of 1990 Germany .
44 46 299 of 1995 Germany .

[21] Appl. No.: **09/128,383**

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[57] **ABSTRACT**

[51] **Int. Cl.⁷** **H01R 13/44**

[52] **U.S. Cl.** **439/144; 439/521**

[58] **Field of Search** 439/138, 142,
439/144

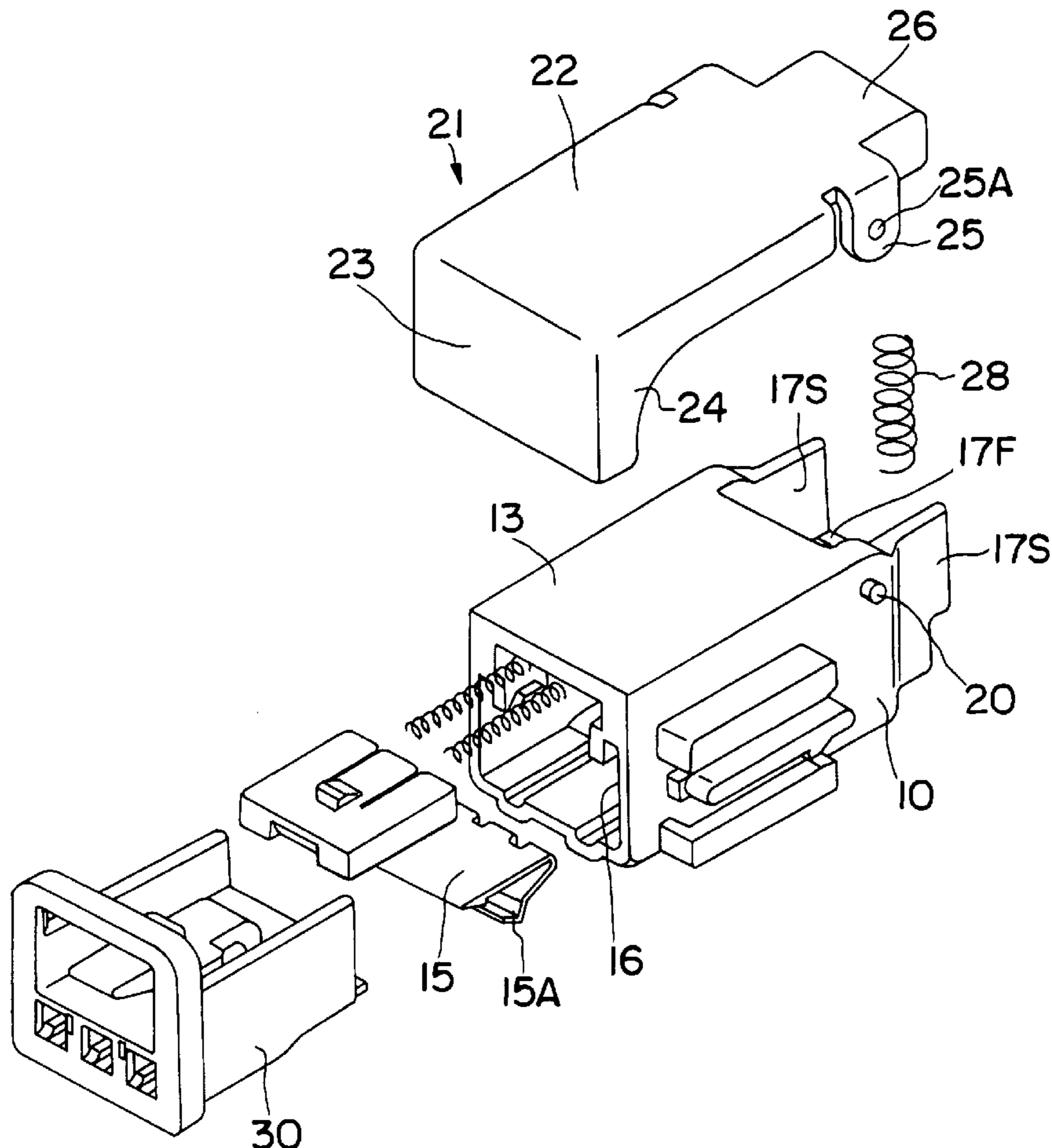
A connector is constructed to reduce a risk of malfunction or impairment of the connector due to the entrance of dust and/or external matter thereinto. The entrance of external matters into a receptacle 13 is prevented because an opening 16 of the receptacle 13 is normally kept closed by a cover 21 biased by a spring member 28. The cover 21 is temporarily opened against the biasing force of the spring member 28 during the insertion and withdrawal of the female connector housing 30.

[56] **References Cited**

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9 Claims, 4 Drawing Sheets



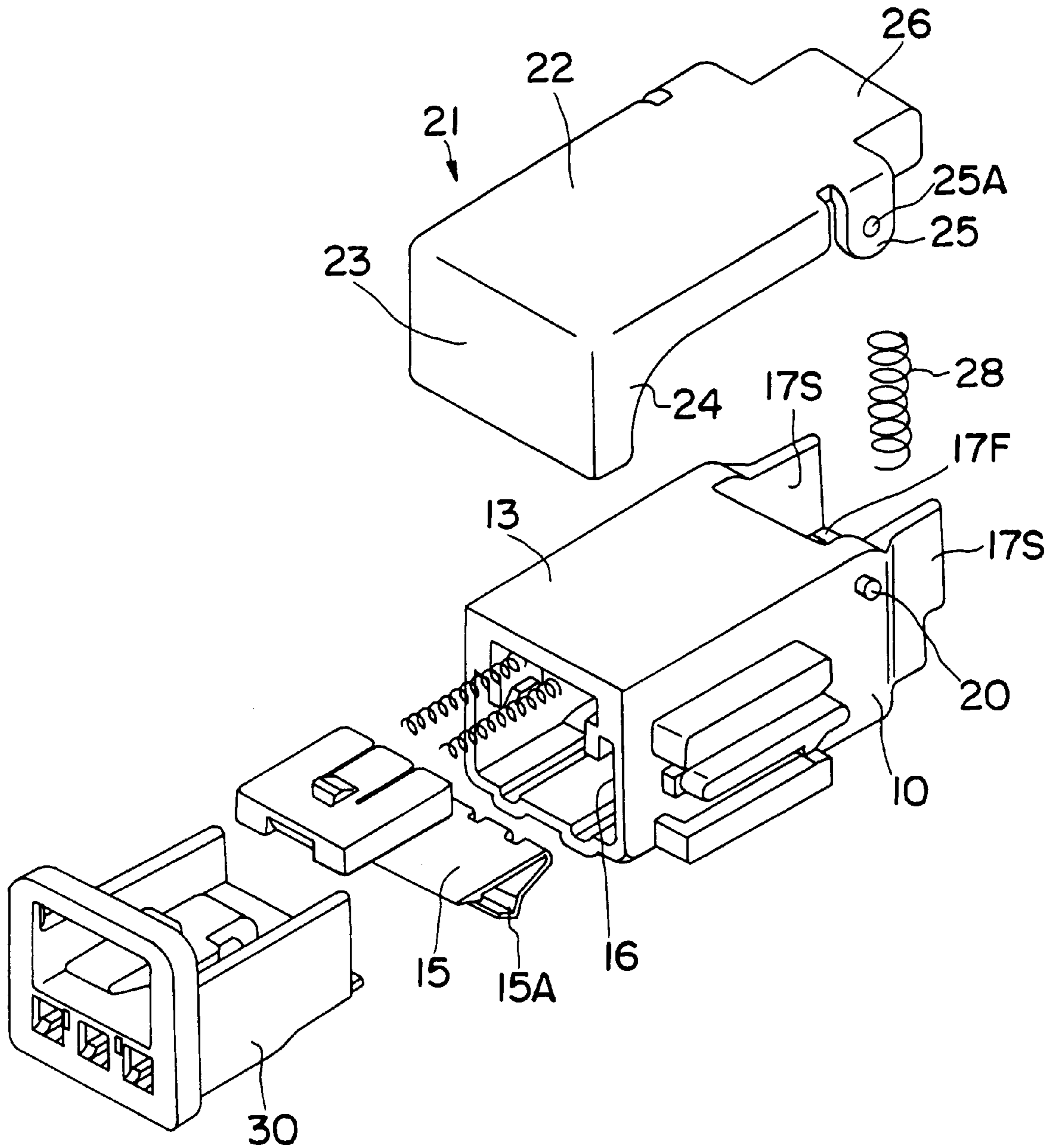
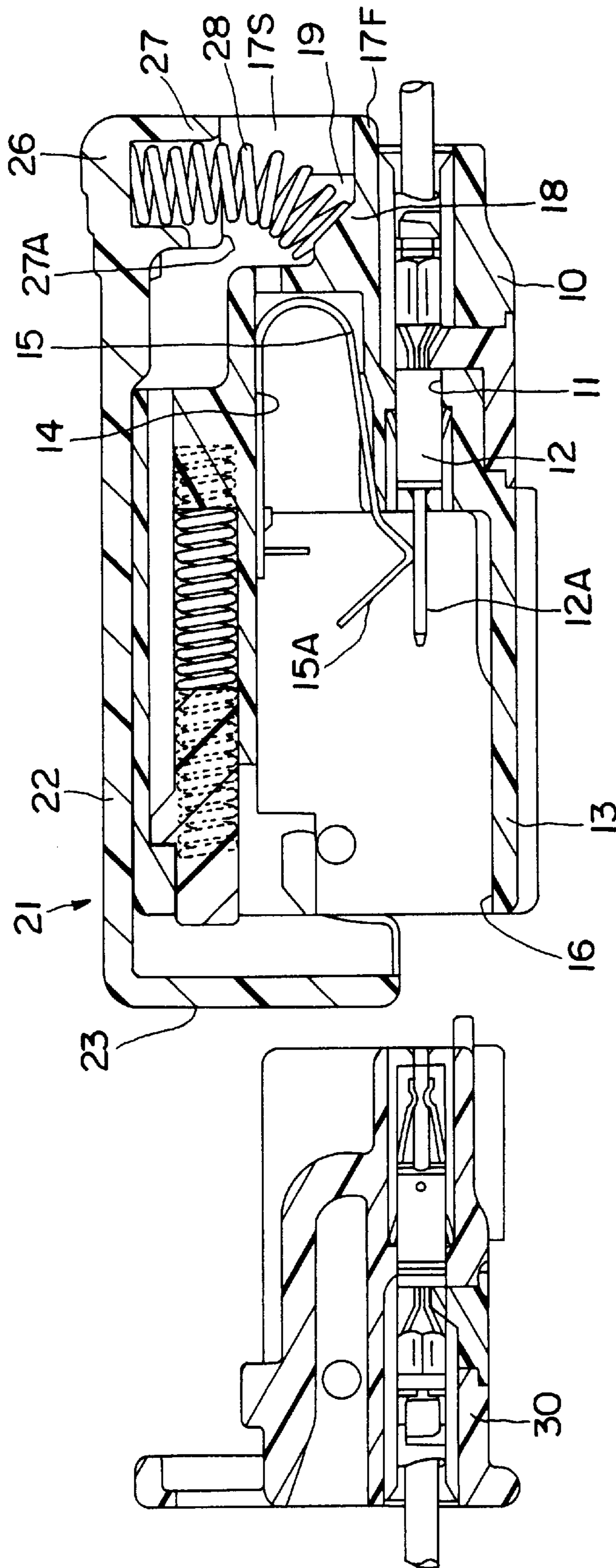


FIG. 1



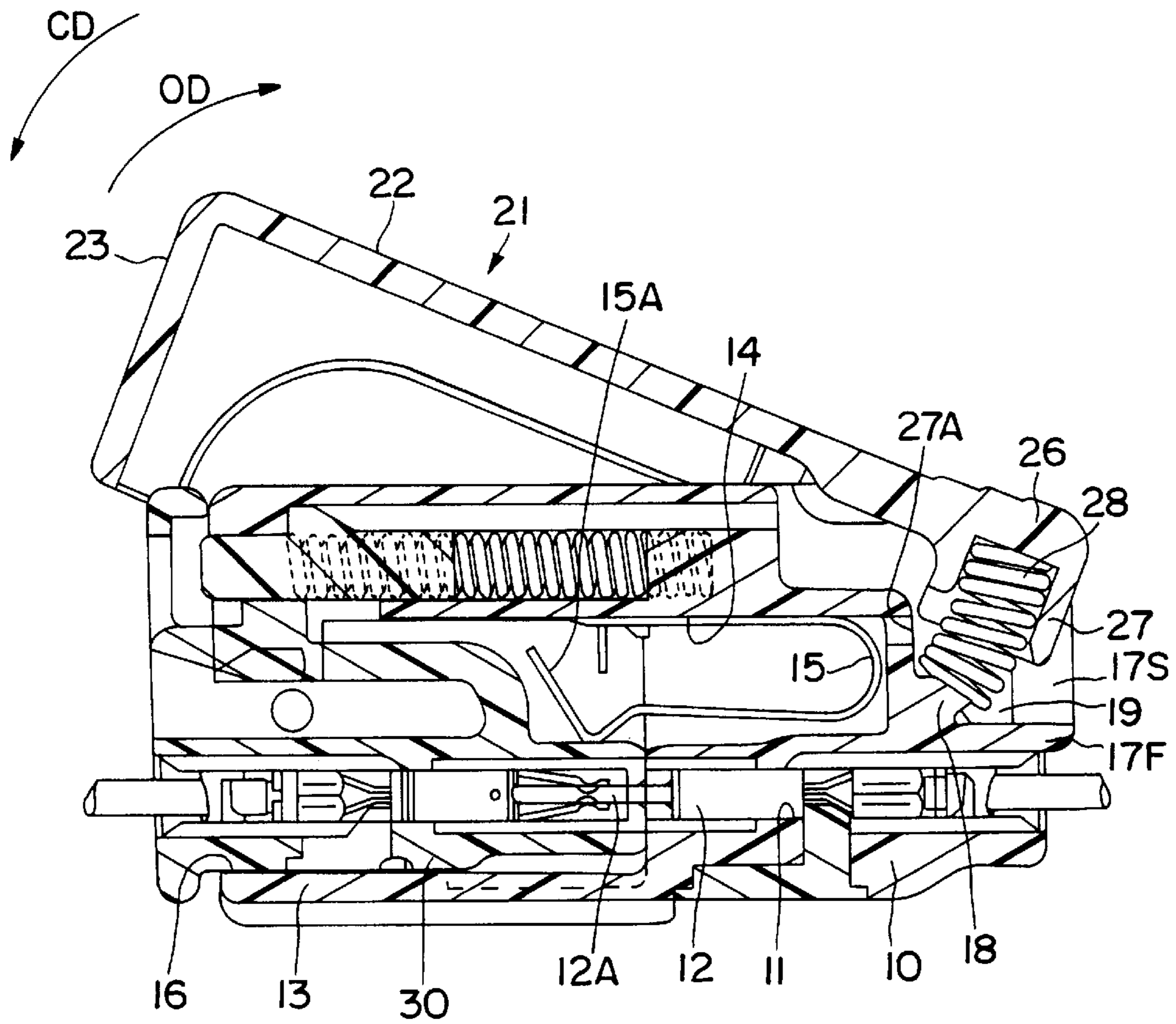


FIG. 3

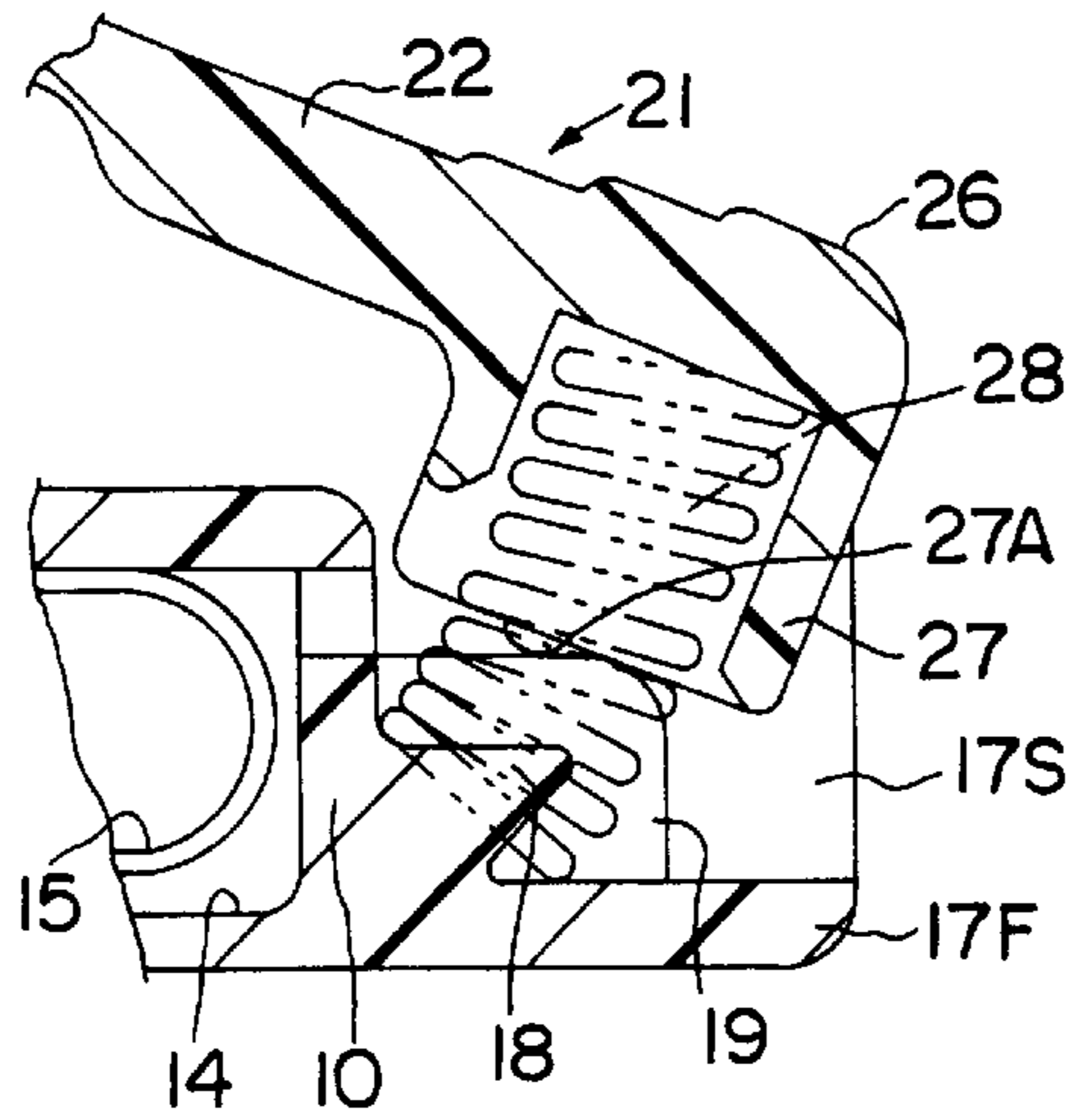


FIG. 4

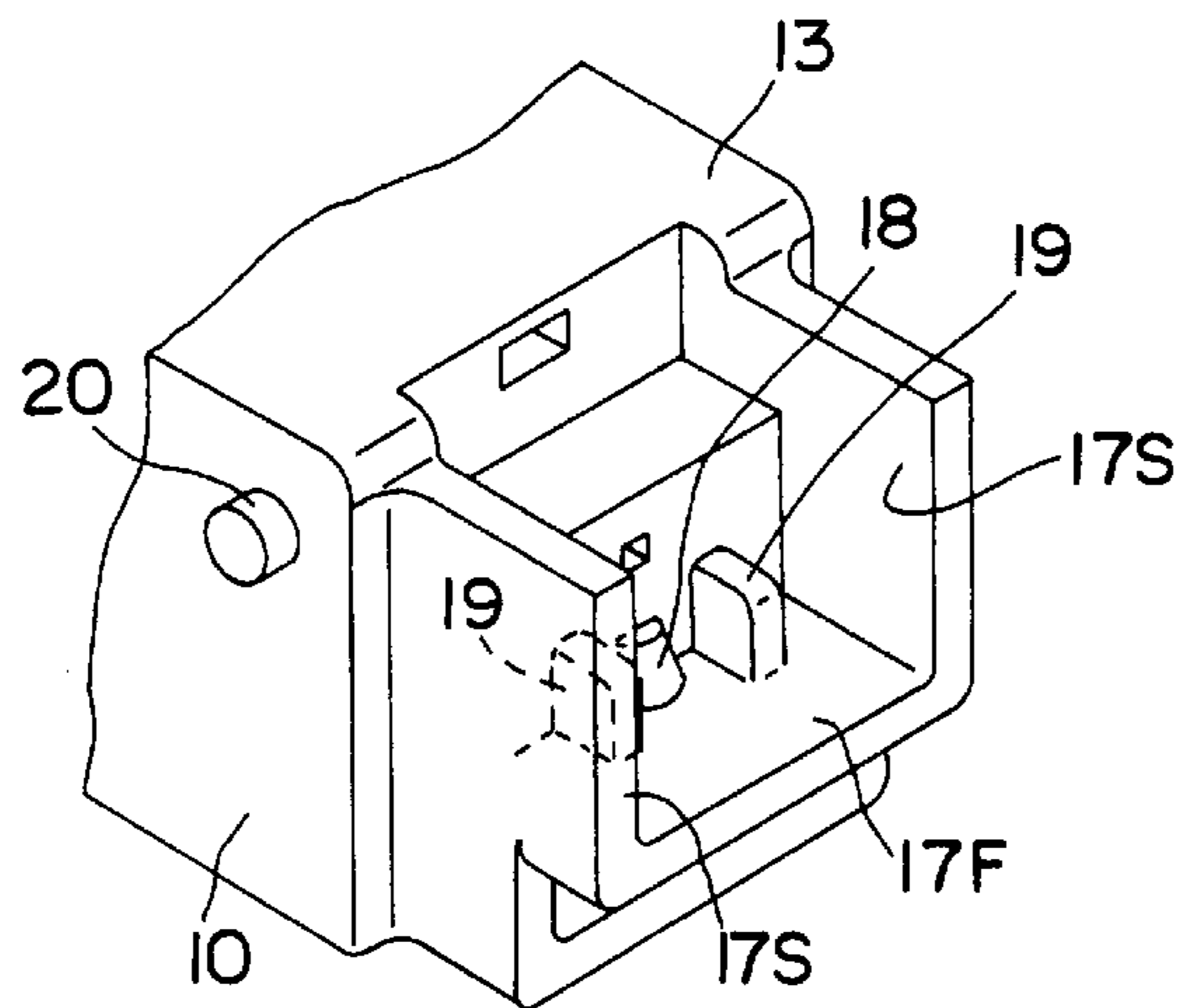


FIG. 5

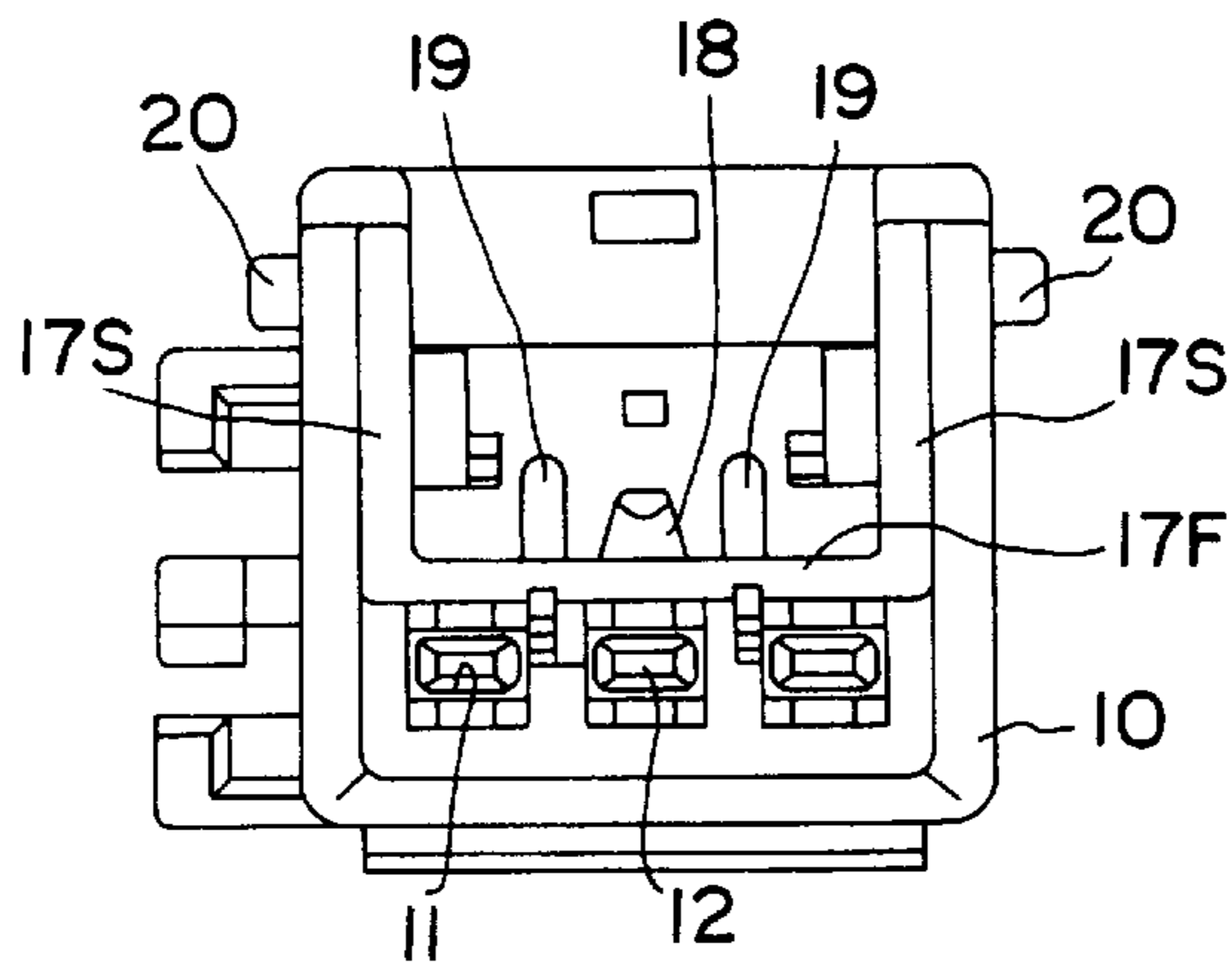


FIG. 6

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CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a connector provided with a cover for substantially covering an opening of a receptacle for a mating connector housing.

2. Description of the Prior Art

A prior art male connector housing is provided with a receptacle for accommodating a female connector housing and has a plurality of male terminal fittings assembled inside with the leading ends projecting into the receptacle. The prior art female connector housing is configured and dimensioned to be fit into the receptacle and has a plurality of female terminal fittings corresponding to the male terminal fittings assembled inside. When the female connector housing is fitted into the receptacle of the male connector housing, the female and male terminal fittings are brought into contact with each other, thereby establishing an electrical connection.

EP-A-0 777 301 shows a prior art connector having a double-lock cover, which is pivotally mounted on the connector housing and is to be closed when a mating connector is fitted in a connector receptacle provided in the connector housing. However, the above referenced prior art double-lock cover is biased by a biasing means in a direction to open the connector receptacle thus allowing the entrance of dust and/or external matter into the connector receptacle.

In view of the above, an object of the present invention is to reduce a risk of malfunction or impairment of the connector by the entrance of dust and/or external matter when the cover is in its rest position.

SUMMARY OF THE INVENTION

A connector in accordance with the subject invention comprises a connector housing provided with a receptacle for accommodating at least partially a mating connector housing. A cover is displaceable between positions to substantially open and substantially close an opening of the receptacle for allowing the at least partial insertion of the mating connector housing into the receptacle, and a spring member is provided for biasing the cover in a closing direction.

Since the cover is normally held in the position to substantially close the opening of the receptacle by being biased by the spring member, the entrance of dust and/or external matters into the receptacle can be prevented.

According to a preferred embodiment of the invention, the connector further comprises an opening degree restricting means for restricting any further displacement of the cover in an opening direction after the cover is opened to a specified or predetermined or predetermined opening degree.

Accordingly, an opening degree of the cover is restricted in the case that a cover for opening and closing an opening of a receptacle for a mating connector housing is provided and is biased to close the opening. Thus malfunction or impairment of the biasing function of the spring is avoided, thereby improving the overall operability of the connector.

The mating connector housing may be at least partially inserted into and withdrawn from the receptacle by temporarily opening the cover against the biasing force of the spring member. At this time, any further displacement of the cover in the opening direction is prevented by the opening degree restricting means after the cover is opened to the

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specified degree. This preferably prevents the spring member from being excessively deformed due to an excessive opening of the cover. Further, if it is determined as an operation manual that the cover can be opened to a position where it is restricted by the opening degree restricting means, the interference of the mating connector housing and the cover during the insertion and withdrawal due to an insufficient opening of the cover can be prevented.

According to a further preferred embodiment of the invention, the opening degree restricting means comprises at least one wall extending along the spring member.

Since the opening degree restricting means comprises the at least one wall extending along the spring member, it can protect the spring member from the interference of external matter and can act to guide the spring member during the mounting of the spring member.

Further preferably, the opening degree restricting means comprises two walls extending substantially along a portion of the spring member and fixed to the connector housing and/or the cover.

Most preferably, the opening degree restricting means is provided on the connector housing and substantially interacts with a contact portion of the cover, when the cover reaches the predetermined or predetermined opening degree.

According to a further preferred embodiment, the opening degree restricting means is provided such that when the cover reaches its predetermined or predetermined opening degree, the spring member is deformed elastically to the extent that it is still within a permissible elasticity range where the spring member normally can be restored elastically.

Preferably, the spring member is provided integrally or unitarily on the connector housing and/or on the cover.

Further preferably, the spring member is fixed or positioned on the connector housing by means of a spring bearing projection, which preferably is shaped substantially semiconically.

Most preferably, the cover is hinged pivotally on the connector housing by a hinge means comprising a support shaft provided on either one of the connector housing and the cover and a bearing portion provided on the other of the connector housing and the cover. The spring member acts at a side of the connector housing and the cover substantially opposite of the side where the opening for the insertion of the mating connector is provided.

These and other objects, features and advantages of the present invention will become more apparent upon a reading of the following detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of a connector according to a first embodiment.

FIG. 2 is a section of connector housings in a detached state.

FIG. 3 is a section of the connector housings at an intermediate stage of the connection.

FIG. 4 is an enlarged partial section showing a state where the opening degree of a cover is restricted.

FIG. 5 is an enlarged partial perspective view of the male connector housing with the cover and a spring member detached therefrom.

FIG. 6 is a rear view of the male connector housing with the cover and a spring member detached therefrom.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A male connector housing in accordance with the subject invention is identified by the numeral **10** in FIGS. 1–6. The male connector housing **10** has a plurality of male terminal fittings **12** accommodated in cavities **11** formed at a lower portion of the male connector housing **10**. Tabs **12A** at the leading ends of the male terminal fittings **12** project into a receptacle **13** which is formed in the male connector housing **10** to project substantially forwardly. Above the cavities **11** is formed a terminal accommodation space **14** substantially communicating with the receptacle **13**. A short-circuiting terminal fitting **15**, preferably having a substantially U-shaped cross section when viewed sideways (FIGS. 2 and 3), is accommodated in the space **14**. A plurality of elastically deformable pieces or portions **15A** at the leading end of the short-circuiting terminal fitting **15** are normally simultaneously in contact with the plurality of tabs **12A** to short-circuit the male terminal fittings **12**. An opening is formed at the front end of the receptacle **13** to define a receptacle opening **16**, through which a female connector housing **30** (mating connector housing) is inserted into the receptacle **13**.

The rear end surface of the male connector housing **10**, or a surface substantially opposed to the receptacle opening **16**, is characterized by a lower plate **17F** which extends substantially backwardly from the bottom edge of the rear end surface. Side plates **17S** extend substantially backwardly from the side edges or left and right edges of the rear end surface, and are substantially continuously formed with the rear end surface to define a substantially U-shaped frame. A substantially semiconically shaped spring bearing projection **18** is formed at a corner portion where the lower plate **17F** and the rear end surface of the male connector housing are continuous at a right angle. The spring bearing projection **18** projects from a center position with respect to transverse direction obliquely upwardly and to the back.

A pair of restricting walls **19** (opening degree restricting means), that preferably have a substantially rectangular shape when viewed sideways, are formed on the opposite sides of the spring bearing projection **18**. Specifically, this pair of restricting walls **19** are located at the left and right sides of the spring bearing projection **18** so as to conceal the spring bearing projection **18** when viewed sideways and to restrict the pivoting movement of a cover **21** in an opening direction OD, as described more in detail hereinafter.

A pair of support shafts **20** are formed in positions at the rear ends of the opposite side surfaces of the male connector housing **10**, and a cover **21** is rotatably or pivotally supported on these support shaft **20**. The cover **21** is comprised of: a ceiling plate **22**, which can substantially face the upper surface of the male connector housing **10**; a covering plate **23**, which extend at an angle different from 0° or 180°, preferably substantially downwardly from the front edge of the ceiling plate **22** for substantially opening and substantially closing the receptacle opening **16**; and side walls **24** which extend downwardly from the opposite side edges of the ceiling plate **22**. A pair of bearing portions **25** are provided at positions corresponding to the support shafts **20** and preferably extend downwardly from positions of the opposite side edges of the ceiling plate **22** in proximity to the rear edge of the ceiling plate **22**, and bearing holes **25A** formed in the bearing portions **25** are fittable around the support shafts **20**. In other words, the cover **21** is pivotal about the support shafts **20** between a closing position (see FIG. 2) where the covering plate **23** substantially closes the

receptacle opening **16** and an opening position where the covering plate **23** is retracted, preferably substantially upwardly to substantially open the receptacle opening **16**.

An area of the rear end portion of the ceiling plate **22** behind the support shafts **20** acts as a finger contact portion or actuation portion **26**. By pushing this finger contact portion **26** by finger or any other actuator, the cover **21** can be displaced from its closing position to its opening position.

The finger contact portion **26** is formed with a spring bearing tubular portion **27** which projects downwardly to face the spring bearing projection **18**. Between the tubular portion **27** and the projection **18** a spring member **28** is mounted or fitted. The spring member **28** preferably is made of a compression coil spring. Specifically, a loose movement of the upper end of the spring member **28** to the front, back, left and right is substantially restricted by being fitted or inserted into the tubular portion **27**, and a loose movement of the lower end thereof to the front, back, left and right is restricted by being fitted on the projection **18**. The cover **21** is biased toward its closing position by the spring member **28**.

The bottom end of the spring bearing tubular portion **27** serves as a contact portion **27A** which can be brought into contact with the restricting walls **19** obliquely from above. The contact of the contact portion **27A** with the restricting walls **19** prevents the cover **21** from being displaced or pivoted further in the opening direction OD (FIG. 3). In a state where the opening degree of the cover **21** is restricted by the restricting walls **19**, the bottom edge of the covering plate **23** is located slightly above the upper edge of the receptacle opening **16** so that the female connector housing **30** can be inserted into the receptacle **13**. With the restricting walls **19** and the contact portion **27A** substantially in contact with each other, the spring member **28** is deformed elastically to a maximum degree, which is still within a permissible elasticity range where the spring member **28** can be normally elastically restored.

The cover **21** is normally held in its closing position where the covering plate **23** substantially closes the receptacle opening **16** by being biased by the spring member **28** in a closing direction CD. Accordingly, dust and external matter are unlikely to enter the receptacle before the female connector housing **30** is fitted thereinto.

When the female connector housing **30** is to be inserted into the receptacle **13**, the cover **21** is displaced from the closing position to the opening position against the biasing force of the spring member **28** by actuating, preferably pushing the finger contact portion **26** substantially from above. At this time, the finger contact portion **26** is strongly pressed until the contact portion **27A** comes into contact with the restricting walls **19**. Then, since the receptacle opening **16** is opened over its entire area, the female connector housing **30** is at least partially inserted or insertable into the receptacle **13** through the receptacle opening **16**. The finger is disengaged from the finger contact portion **26** when the female connector housing **30** is completely accommodated. Consequently, the cover **21** is returned to the closing position (FIG. 2) by the biasing force of the spring member **28**.

As described above, in this embodiment, when the cover **21** is displaced to the specified opening position, any further displacement thereof in the opening direction is prevented by the restricting walls **19**. In this state, the degree of deformation of the spring member **28** is below the elasticity limit. Accordingly, the deformation of the spring member **28** beyond the elasticity limit resulting from an excessive opening of the cover **21** can be prevented securely.

If it is determined as an operation manual that the cover 21 be opened to a position where the contact portion 27A comes into contact with the restricting walls 19, the interference of the female connector housing 30 and the cover 21 during the insertion and withdrawal due to an insufficient opening of the cover 21 can be prevented.

Further, since the restricting walls 19 extend substantially along the spring member 28, the spring member 28 can be protected from the interference from external matter. The restricting walls 19 also act to guide the spring member 28 when the spring member 28 is mounted on the spring bearing projection 18.

The present invention is not limited to the described and illustrated embodiment, but the following embodiments also are embraced by the technical scope of the present invention as defined in the claims. Besides the following embodiments, a variety of other changes can be made without departing from the scope and spirit of the invention as defined in the claims.

Although the restricting walls (opening degree restricting means) are formed on the male connector housing in the foregoing embodiment, it may be formed on the cover 21 according to the invention.

Although the opening degree restricting means is embodied by the walls projecting along the spring member 28 in the foregoing embodiment, it may be formed in a position distanced from the spring member and may not be limited to the walls, but take an other form such as a tubular shape according to the invention.

Although a compression coil spring is used as the spring member 28 in the foregoing embodiment, a torsion coil spring or a leaf spring may also be used as the spring member 28.

Although the spring member 28 is a part separate from the male connector housing 10 and the cover 21 in the foregoing embodiment, it may be integrally or unitarily formed with the connector housing or the cover.

What is claimed is:

1. A connector, comprising:

a connector housing provided with opposed front and rear ends, support shafts extending transversely from the connector housing at locations between the front and rear ends, a receptacle with an opening at the front end of the connector housing for accommodating, at least partially, a mating connector housing, a lower plate extending from the receptacle to the rear end of the connector housing;

a cover having a ceiling plate with opposed front and rear ends, a pair of bearings between the front and rear ends of the ceiling plate pivotally mounted to the support shafts of the connector housing such that said cover is pivotably displaceable between first and second positions, a covering plate extending from said front end of said ceiling plate and dimensioned to substantially open the receptacle when the cover is in the first position for allowing the at least partial insertion of the mating connector housing into the receptacle, and to at least partially close the receptacle when the cover is in the second position, a finger contact portion extending

forwardly from the rear end of the ceiling plate to the bearings thereof and disposed in spaced relation to the lower plate of the connector housing; and

a spring member disposed between the lower plate of the connector housing and the finger contact portion of the cover for biasing the cover in a closing direction and into the second position to at least partially close the opening of the receptacle, whereby forces exerted on the finger contact portion enable opening of the receptacle for the at least partial insertion of the mating connector housing.

2. A connector according to claim 1, wherein the spring member is integrally provided on at least one of the connector housing and the cover.

3. A connector according to claim 1, wherein the connector housing includes a spring bearing projection which is of tapered shape, the spring member being fixed on the spring bearing projection.

4. A connector according to claim 1, further comprising an opening degree restricting means for restricting any further displacement of the cover in an opening direction after the cover is opened to a predetermined opening degree.

5. A connector according to claim 4, wherein the opening degree restricting means is provided on the connector housing and substantially interacts with a contact portion of the cover when the cover reaches the predetermined opening degree.

6. A connector according to claim 4, wherein the opening degree restricting means is provided such that when the cover reaches the predetermined opening degree, the spring member is elastically deformed to an extent that it is still within a permissible elasticity range where the spring member normally can be restored elastically.

7. A connector according to claim 4, wherein the opening degree restricting means comprises at least one wall extending along the spring member.

8. A connector according to claim 7, wherein the opening degree restricting means comprises two walls extending along opposite sides of the spring member and fixed to a selected one of the connector housing and the cover.

9. A connector, comprising:

a connector housing provided with a receptacle having an opening for accommodating, at least partially, a mating connector housing;

a cover which is displaceable between positions to substantially open and substantially close the opening of the receptacle for allowing the at least partial insertion of the mating connector housing into the receptacle;

a spring member for biasing the cover in a closing direction; and

an opening degree restricting means for restricting any further displacement of the cover in an opening direction after the cover is opened to a predetermined opening degree, the opening degree restricting means comprising two walls extending along opposite sides of the spring member and fixed to a selected one of the connector housing and the cover.